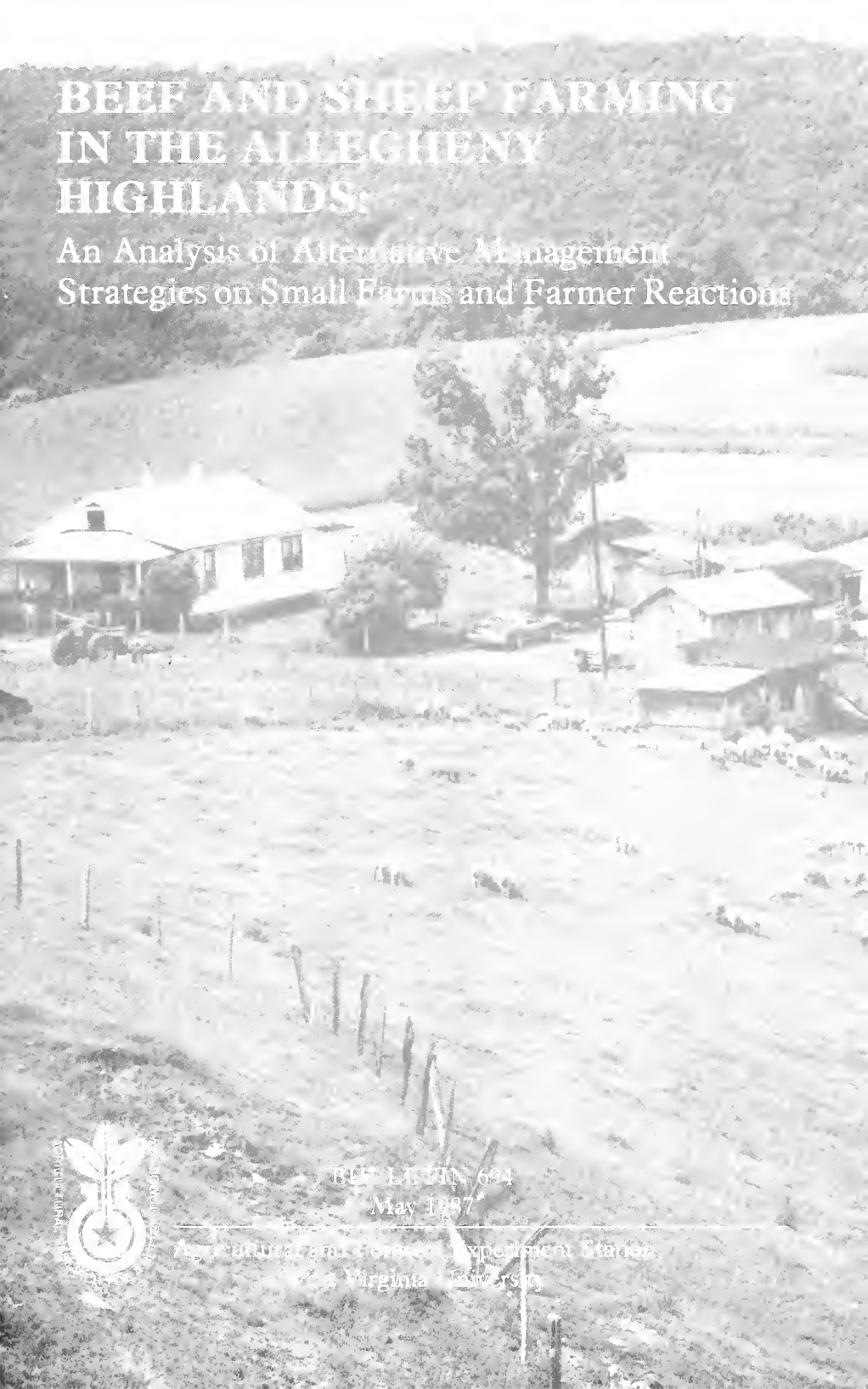
BEEF AND SHEEP FARMING IN THE ALLEGHENY HIGHLANDS:

An Analysis of Alternative Management Strategies on Small Farms and Farmer Reactions



BULLETIN 604
May 1987

Agricultural and Forestry Experiment Stations
West Virginia University

The Authors

Kimberly Reda-Wilson is former Research Assistant and Robert O. Burton, Jr. is former Assistant Professor, Division of Resource Management; Barton S. Baker is Professor, Division of Plant and Soil Sciences; and Paul E. Lewis is Professor, Division of Animal and Veterinary Sciences, West Virginia University Agricultural and Forestry Experiment Station. Reda-Wilson is currently Extension Associate, Virginia Polytechnic Institute and State University. Burton is currently Assistant Professor at Department of Agricultural Economics, Kansas State University. Appreciation is expressed to Anwarul Hoque, Dennis K. Smith, and Mary E. Templeton for reviewing an earlier draft. The authors are responsible for any remaining errors.

West Virginia University
Agricultural and Forestry Experiment Station
College of Agriculture and Forestry
Robert H. Maxwell, Director
Morgantown

Contents

Tables

Figures

Preface

This bulletin is a summary of research performed under U. S. Department of Agriculture cooperative agreement number 58-32U4-0-203, titled "Resource Characterization of Small Farms and Evaluation of Whole Farm Systems Using Existing Small Farm Data." Additional details of the research may be found in Reda, Kimberly Jane, "An Economic Analysis of Management Strategies on Small, Beef/Sheep Farms in West Virginia," M. S. thesis, West Virginia University, 1984.

Beef and Sheep Farming in the Allegheny Highlands: An Analysis of Alternative Management Strategies on Small Farms and Farmer Reactions

Kimberly Reda-Wilson, Robert O. Burton, Jr., Barton S. Baker, and Paul E. Lewis

Introduction

During the past forty years, the agricultural sector of the United States has become highly mechanized, technologically advanced, and eminently productive. This transformation has enabled some farm operators to expand and prosper while providing an abundant food supply (Orden and Smith).

Many farms in West Virginia are located on rough terrain unsuited to highly mechanized, intensive cultivation typical of the larger operations which began to dominate the industry in the 1950s. This structural change in farming is evidenced by the 79 percent decrease in West Virginia farm numbers from 1945–1978 (U.S. Department of Commerce). The remaining small, livestock/forage units, characteristic of the state's farms, are faced with persistent low income.[1] Therefore, research is needed to evaluate the income potential for alternative management strategies on small, livestock/forage farms.

Research Objectives

This research was intended to determine if management practices used by farmers who had participated in the Allegheny Highlands Project (AHP) had led to optimal profit.[2] The general objective was to evaluate the profitability of a greater use of technology.

The specific objectives of the study were:

1. to establish a profile of characteristics for an average full-time and part-time Allegheny Highlands Project farm;

[1]The average net farm income was lower for 60 percent of USDA small farms in West Virginia than the reported non-metropolitan median family income ($14,800) for West Virginia in 1979 (Crecink).

[2]Allegheny Highlands Project, hereafter referred to as AHP or Project, was a ten-year (1970–79) research and demonstrational program designed to revitalize the beef and sheep industries in West Virginia (Baker et al.). The operation, co-sponsored by the West Virginia University (WVU) College of Agriculture and Forestry and the Rockefeller Foundation, was centered in a nine-county area in north-central West Virginia.

2. to develop annual pasture, mixed hay, beef, and sheep enterprise budgets for full-time and part-time farms;
3. to integrate the profile of characteristics and budgets into synthetic whole-farm computer models representing an optimally managed full-time and part-time farm;
4. to prepare budgets and whole-farm models of alternative production techniques;
5. to evaluate the economic feasibility of alternative production techniques;
6. to identify the most promising alternative management systems; and
7. to evaluate the potential for adoption of the more promising alternative management systems from the AHP farm operator's viewpoint.

Selection of Farm Categories

Based on the statistical technique, discriminant analysis, and the desire to limit the analysis to two groups, 56 AHP farms were classified as either full or part time.[3] The full-time category was composed of 26 farms whose labor inputs, as originally judged in the Project, were full-time with no outside income or full-time with outside income. The part-time group was composed of 30 farms whose time inputs were part-time with farming as a major activity, part-time with farming as a minor activity, or retired.

Data Sources

Production, income and expense, and inventory data obtained from AHP were used as the primary data source. Data collection had been coordinated through a computerized record keeping system, the Electronic Farm Accounting Program (ELFAC),[4] used by cooperating farmers (Baker et al., pp. 1–2). Data not available from the ELFAC records were obtained from: (1) published research data; (2) estimates of qualified, experienced agricultural scientsts;[5] (3) research results; and (4) surveys of farmers.

Selected population characteristics for the years 1978 and 1979 are presented in Table A-1.[6] Since the study was based on a 1979 price level, indexes were used to convert 1978 prices to the 1979 price level prior to averaging (USDA 1981, p. 452). Additional explanations of data sources may be found in the M.S. thesis by Reda.

---

[3]Discriminant analysis was used to evaluate alternative combinations of groups of farms categorized earlier by AHP personnel (Baker et al., pp. 9–10).

[4]Electronic Farm Accounting Program is a Vermont-based operation offered through the Division of Resource Management at WVU.

[5]The authors acknowledge the assistance of Keith Inskeep, animal scientist, West Virginia College of Agriculture and Forestry and Phil Osborne, livestock specialist from the Center for Extension and Continuing Education at WVU.

[6]The authors acknowledge the assistance of Randy Martin, former research assistant at WVU.

Farm Descriptions Based on Actual Data

The average full-time farm consisted of 480 acres valued at $60,340. Based on inventory data, approximately 43.8 percent of the land was used to produce pasture, 13.5 percent for crops (mostly hay), and 42.7 percent for woodland and other uses. Thus, for purposes of livestock production, land was predominantly used for pasture. A total of $2,500 per farm was spent for lime ($486.00) and fertilizer ($2,014) or $9.09 per acre of pasture and tillable land. The average full-time farmer owned 1 baler, 4 pieces of other hay harvesting equipment, 1 piece of corn harvesting equipment, 3 tillage implements, 3 tractors, and 2 wagons (Table A-2).

The majority of full-time producers raised a combination of beef and sheep (Table 1). The total number of animal units per farm averaged 109, of which approximately 76 percent was beef, 21 percent sheep, and 3 percent other livestock. The full-time farmer spent approximately $6.00 for veterinary expenses, $3.00 for salt and minerals, and $1.00 for livestock supplies per animal unit. Approximately $7.00 [$11.00] was spent per cow [ewe] for beef [sheep] concentrates and $636 worth of hay per farm was purchased.

Table 1
Selected characteristics of AHP farms, 1978 and 1979.[a]

Category	Unit	Quantity	
		Full time	Part time
Farms:	Number	26	30
Beef/sheep farms	Number	18	7
Beef farms	Number	7	21
Sheep farms	Number	1	2
Land Inventory			
Crop	Acres	65	45
Pasture	Acres	210	94
Woodland	Acres	201	103
Other	Acres	4	3
Pasture yields per acre	TDM[b]	1.95	1.75
Hay yields per acre[c]	TDM	2.88	2.76
Beef statistics:			
Cow	Number	66	32
Cow death rate	Percent	2	2
Calf birthdate from Nov. 1	Days	130	124
205-day weight	Pounds	465	466
Marketable calf crop	Percent	88	86
Calf sale date from Nov. 1	Days	342	344
Calf weight	Pounds	483	472
Value per calf sold	Dollars	349	334

(continued)

Table 1 (continued).

Category	Unit	Quantity	
		Full time	Part time
Sheep Statistics:			
Ewe	Number	137	56
Sheep death rate	Percent	8	11
Lamb birthdate from Nov. 1	Days	72	54
Marketable lamb crop	Percent	120	121
Lamb sale date from Jan. 1	Days	279	240
Lamb weight	Pounds	97	90
Value per lamb sold	Dollars	59	53
Livestock expenses:			
Veterinarian and medical	Dollars	655	177
Salt and minerals	Dollars	305	104
Beef concentrate	Dollars	430	295
Sheep concentrate	Dollars	1,553	461
Livestock supplies	Dollars	128	50
Farm finances:			
Operating receipts	Dollars	32,871	9,678
Operating expenses	Dollars	24,765	7,859
Assets	Dollars	128,806	74,893
Liabilities	Dollars	12,970	10,174

[a]When calculating means missing data were ignored. Consequently, average cow [ewe] numbers are based only on farms which produce cattle [sheep].

[b]Tons of dry matter.

[c]These hay yields include .35 and .33 tons of dry matter which were grazed on the full-time and part-time farms, respectively.

Approximately 67 percent of the operating receipts came from the sale of beef, 29 percent from sheep, 2.5 percent from wool, and 1.5 percent from hay and grain. Operating receipts minus operating expenses were $8,106 per farm or $74 per animal unit.

Other data used to characterize an average full-time AHP farm included: 32 pieces of equipment per farm; $14,632, depreciated value of machinery; $568, repairs to machinery; $2,740, fuel and operation of trucks and tractors; $305, hired machinery; and $870, repairs to real estate. The net worth of a full-time AHP farm was $115,836.

The average part-time farm consisted of 245 acres. Approximately 38.4 percent of the land was used to produce pasture, 18.4 percent for crops (mostly hay), and 43.2 percent for woodland and other uses. Thus, land use patterns were similar for both groups of farms. A total of $857 was spent for lime ($170) and fertilizer ($687) or $6.17 per acre of pasture and tillable land. The average part-time farmer owned 1 baler, 3 pieces of other hay harvesting equipment, 1 piece of corn harvesting equipment, 2 tillage implements, 2 tractors, and 1 wagon (Table A-3).

Unlike the full-time farmers, the majority of part-time farmers raised only beef. The total number of animal units per farm averaged 44, of which approximately 77 percent was beef, 19 percent sheep, and 4 percent other livestock. The part-time farmer spent approximately $4.00 for veterinary expenses, $2.00 for salt and minerals, and $1.00 for livestock supplies per animal unit. Aproximately $9.00 [8.00] was spent per cow [ewe] for beef [sheep] concentrates and $172 worth of hay was purchased.

Approximately 78 percent of the total operating receipts came from the sale of beef, 17 percent from sheep, 2 percent from wool, and 3 percent from hay and grain. Operating receipts minus operating expenses were $1,819 per farm or $41 per animal unit.

Other data from part-time farms included: 19.5 pieces of equipment per farm; $8,954, depreciated value of machinery; $247, repairs to machinery; $1,567, fuel and operation of trucks and tractors; $25, hired machinery; and $440, repairs to real estate. The average net worth of a part-time AHP farm was $64,719.

Typical Budgets

Annual production levels, costs, and returns to fixed resources and feed[7] were estimated for pasture, mixed hay, beef, and sheep. The budgets representing a full-time farm reflected the following: (1) An average pasture yield of 1.95 tons of dry matter per acre for an annual outlay (variable costs) of $14.19; (2) An average hay yield of 2.88 tons of dry matter per acre for an annual outlay of $58.19; (3) A 60-cow herd producing 53 calves per year whose average market weight was 483 pounds. The annual returns to fixed resources and feed per cow were $244.35; and (4) A 150-ewe flock producing 180 lambs whose average market weight was 97 pounds. The annual returns to fixed resources and feed per ewe were $53.67.

Statistics for the part-time farm were: (1) Pasture yield of 1.75 tons of dry matter at $9.19 per acre; (2) Hay yield of 2.76 tons of dry matter at $56.45 per acre; (3) A 30-cow herd, 26 calves, 472 pounds per marketed calf, and $211.81 returns to fixed resources and feed per cow; and (4) A 50-ewe flock, 61 lambs, 90 pounds per marketed lamb, and $43.17 returns to fixed resources and feed per ewe.

---

[7]Returns to fixed resources and feed (total revenue minus variable costs) and returns to land, risk, management, and feed (total revenue minus variable and fixed costs) were both assessed in the budgets. Feed costs were accounted for in the whole-farm computer models so feed costs were not subtracted from the budgeted returns reported in this selection. Since many of the producers represented by the models are known to be reluctant to borrow money for farm operations, interest on operating capital was not included as a cash (variable) cost.

Linear Programming Structure of Typical Farms

Given the AHP farmers available land, labor, operating capital and facilities, and restricting enterprises to those commonly found on farms in 1979, a linear programming (LP) model[8] was used to estimate potential returns for each farm category, assuming an optimally managed production process. The enterprise input-output relationships were incorporated into a matrix table. The objective in solving the model was to determine the cropping and livestock enterprise combination which would maximize returns to fixed resources. Fixed resources included owned land, on-farm labor, capital, machinery, buildings, equipment, and management.

Crop and livestock production coefficients, costs, and returns for a full-time farm were derived from enterprise budgets. The activities representative of the four most common enterprises included in the full-time, typical beef/sheep farm model were pasture, hay, beef, and sheep (Table 2). Other activities included in this base model were those allowing for the purchase of inputs (corn and hay) and disposal of intermediate products (pasture and hay). Transfer columns were designed to depict the availability of pasture from one month to another. Land, capital, and labor restrictions during the critical seasons were included.[9] The production activities were arranged as a series of columns. The resources required for these production alternatives were listed by row (Tables 2 and 3).

Depending on the personal objectives of the manager, restraints may be subjective in nature. Thus, livestock models representing the production of only beef or only sheep were analyzed. The full-time, typical sheep [beef] model was prepared by deleting the beef (sheep and corn purchase[10]) activity from the format of the original beef/sheep model.

Based on part-time AHP data, the LP model was designed to reflect a typical part-time beef/sheep farm's level of performance (Table 3). Part-time models representing only beef or only sheep production were also developed.

Comparison of Typical Models to Actual Data

In order to assess the practical validity of the LP models, the models were compared to actual data. This assessment is beneficial because the more closely the model results conform to actual statistics the more confidence may be placed in recommendations based on the models.

---

[8]Linear programming is a mathematical technique providing for the solution of a linear objective function subject to a set of resource limitations (Beneke and Winterboer).

[9]Land and capital constraints were taken from AHP data. Labor requirements were based on information from Purdue University (Coop. Ext. Serv.) and Willow Bend Demonstrational Farm.

[10]The purchase of corn is not necessary for the production of beef cattle.

Table 2

Typical full-time AHP beef/sheep farm model.[a]

(Units)		Growpast (Ac)	Growhay (Ac)	Sumhay (Lb dm)	Buycorn (Cwt)	Buyhay (Tn)	Grow corn for Cow	Grow silage for Ewe	Sellpast (Cow)	Sellhay (Tn)	Apr.-May (Lb dm)	May-June (Lb dm)	June-July (Lb dm)	July-Aug. (Lb dm)	Aug.-Sept. (Lb dm)	Sept-Oct. (Lb dm)		RHS[b]
($)	Objf	-14.19	-58.19		-4.47	-50.01	244.35	53.67	20.40	50.00							N	0
(Ac)	Hayland		1.00														≤	65
(Ac)	Totland	1.00	1.00														≤	275
(Cwt)	Corn				1.00			1.00									≤	0
(Lb dm)	Hay		-5,060.00	1.00		-1,760.00	5,165.00	527.00		1,760.00							≤	0
(Hr)	Ann-labor	.42	10.46				8.00	5.00									≤	0
(Hr)	Calvlmb						2.88	3.23									≤	600
(Hr)	Jun-labor		5.23				.28	.10									≤	300
($)	Opcap	14.19	58.19		4.47	50.01	71.33	18.02									≤	24,765
(Lb dm)	Aprfeed	-117.00									1.0						≤	0
(Lb dm)	Mayfeed	-1,229.00					1,489.00	235.00	1,200.00		-.9	1.0					≤	0
(Lb dm)	Junfeed	-819.00					1,489.00	235.00	1,200.00			-.9	1.0				≤	0
(Lb dm)	Julyfeed	-683.00					1,647.00	272.00	1,200.00				-.9	1.0			≤	0
(Lb dm)	Augfeed	-546.00					1,647.00	272.00	1,200.00					-.9	1.0		≤	0
(Lb dm)	Sept-feed	-312.00	-700.00				1,910.00	333.00	1,200.00						-.9	1.0	≤	0
(Lb dm)	Octfeed	-195.00		-1.00			1,910.00	333.00	1,200.00							-.9	≤	0

[a]For the objective function row (Objf), a negative sign indicates a cost while a positive sign indicates a return. For other rows, a negative sign indicates that an activity furnishes a resource while a positive sign indicates an activity uses a resource.

[b]Maximum Resources Available.

Table 3

Typical part-time AHP beef/sheep farm model.[a]

(Units)		Growpast (Ac)	Growhay (Ac)	Sumhay (Lb dm)	Buycorn (Cwt)	Buyhay (Tn)	Grow corn for Cow	Grow silage for Ewe	Sellpast (Cow)	Sellhay (Tn)	Apr.-May (Lb dm)	May-June (Lb dm)	June-July (Lb dm)	July-Aug. (Lb dm)	Aug.-Sept. (Lb dm)	Sept-Oct. (Lb dm)		RHS[b]
($)	Objf	-9.19	-56.45		-4.47	-50.01	211.81	43.17	20.40	50.00							N	0
(Ac)	Hayland		1.00														≤	45
(Ac)	Totland	1.00	1.00														≤	139
(Cwt)	Corn				1.00			1.00									≤	0
(Lb dm)	Hay		-4,860.00	1.00		-1,760.00	5,165.00	530.00		-1,760.00							≤	0
(Hr)	Ann-labor	.42	10.46				8.00	5.00									≤	0
(Hr)	Calvlmb						2.88	3.23									≤	360
(Hr)	Jun-labor		5.23				.28	.10									≤	180
($)	Opcap	9.19	56.45		4.47	50.01	85.74	22.09									≤	7,859
(Lb dm)	Aprfeed	-105.00									1.0						≤	0
(Lb dm)	Mayfeed	-1,103.00					1,486.00	237.00	1,200.00		-.9	1.0					≤	0
(Lb dm)	Junfeed	-735.00					1,486.00	237.00	1,200.00			-.9	1.0				≤	0
(Lb dm)	Julyfeed	-613.00					1,641.00	274.00	1,200.00				-.9	1.0			≤	0
(Lb dm)	Augfeed	-490.00					1,641.00	274.00	1,200.00					-.9	1.0		≤	0
(Lb dm)	Sept - feed	-280.00	-661.00				1,898.00	336.00	1,200.00						-.9	1.0	≤	0
(Lb dm)	Octfeed	-175.00		-1.00			1,898.00	336.00	1,200.00							-.9	≤	0

[a]For the objective function row (Objf), a negative sign indicates a cost while a positive sign indicates a return. For other rows, a negative sign indicates that an activity furnishes a resource while a positive sign indicates an activity uses a resource.

[b]Maximum Resources Available.

Beef/Sheep Models

The acres of pasture and hay in the full-time beef/sheep model F-1 solution were 101 and 83 percent, respectively, of actual production levels for each enterprise (Table 4). The number of cows and ewes were 97 and 96 percent, respectively, of actual production quantities. The modeled value of hay purchased was approximately four times greater than the actual value, while net income was three percent greater than the corresponding figure in actual data.

Differences between actual and modeled results for the part-time beef/sheep model P-1 were more extreme than those for the full-time group (Table 5). Measured as a percentage of actual 1979 production, differences included: acres of pasture, 137 percent; acres of hay, 80 percent; number of cows, 59 percent; number of sheep, 188 percent; and net income, 140 percent. Net income figures were pointedly dissimilar as a result of the income and costs associated with a larger number of sheep in the optimal solution than actual data and modeled income from hay sales which was approximately four times greater than actual income from hay sales.

Beef Models and Sheep Models

Differences between actual and modeled data for the full-time, all beef model F-2, measured as a percentage of actual data, included: acres of pasture, 108 percent; acres of hay, 70 percent; and number of cows, 96 percent. The greatest disparity between actual and model data was with expenses for purchased hay and net income, which were more than fifteen and nine times greater, respectively, than actual data. Since the modeled production was so different from actual production, there is reason to suspect the income and cost variables used to model the full-time beef farm and/or the validity of the actual data.

Differences between the optimal solutions of the typical beef model P-2 and actual production levels of an average part-time, all beef farm were not as great as those for the full-time category. Measured as a percentage of actual data, they included acres of pasture, 108 percent; acres of hay, 67 percent; number of cows, 106 percent; value of hay purchased, 375 percent; and net income, 227 percent.

Due to the low number of sheep farms, a comparison was not made between model F-3 and P-3 results and actual data.

When interpreting the models' results, one should keep in mind the following considerations: the AHP cooperator's primary farming objective was not always profit; the average price received per CWT of calf was higher in 1979 than in the eight preceding or two following years;[11] and operating capital was a restraining resource only in LP models P-10 and P-12.

---

[11]Calf prices per CWT in years 1971–81 were as follows: $36.80, $46.30, $57.50, $35.70, $27.40, $31.70, $34.50, $57.90, $79.50, $79.30, and $66.90 (USDA and WVDA).

Table 4

Summary of actual average data for full-time AHP farms and LP model results.[a]

Category (unit)	Net income (dollars)	Cow (head)	Ewe (head)	Pasture (acres)	Hay (acres)	Corn purch. (cwt)	Hay purch. (dollars)	Hay sold (dollars)	Pasture sold (dollars)	Labor hired for calving/ lambing (dollars)	Labor hired for hay harvesting (dollars)
Project data:											
All farms	8,106	66	137	210	65	UN	636	218	UN	UN	UN
Beef/sheep farms	11,205	60	139	221	63	UN	813	110	UN	UN	UN
Beef farms	1,057	83	NA	206	76	UN	270	515	UN	UN	UN
Model results:											
(F-1)	11,497	58	134	223	52	134	3,073	0	0	NA	NA
(F-2)	9,203	80	NA	222	53	NA	4,112	0	0	NA	NA
(F-3)	9,845	NA	186	79	54	186	0	4,954	0	NA	NA
(F-4)	11,320	58	134	223	52	134	3,073	0	0	NA	NA
(F-5)	8,957	80	NA	222	53	NA	4,112	0	0	NA	NA
(F-6)	12,663	47	139	223	52	139	2,673	0	0	NA	NA
(F-7)	10,176	66	NA	221	54	NA	3,606	0	0	NA	NA
(F-8)	7,507	NA	186	78	56	186	0	4,954	0	NA	NA
(F-9)	5,352	NA	186	65[b]	NA	186	3,115	NA	245	NA	NA
(F-10)	15,786	0	459	210	65	459	0	2,477	0	2,276	222
(F-11)	9,928	77	NA	210	65	NA	1,938	0	0	0	160
(F-12)	15,786	NA	459	210	65	459	0	2,477	0	2,276	222

Table 4. Continued

Resource (unit)	Hayland		Total land		Annual labor[c] (hours)	Calving and lambing labor		Hay harvesting labor		Operating capital (dollars)
	Amount (acres)	Shadow price (dollars)	Amount (acres)	Shadow price (dollars)		Amount (hours)	Shadow price (dollars)	Amount (hours)	Shadow price (dollars)	
Project data:										
All farms	65	NA	275	NA	UN	UN	NA	UN	NA	24,765
Beef/sheep farms	63	NA	284	NA	UN	UN	NA	UN	NA	27,553
Beef farms	76	NA	282	NA	UN	UN	NA	UN	NA	20,173
Model results:										
(F-1)	52	NA	275	12	1,768	600	6	300	15	16,398
(F-2)	53	NA	275	18	1,289	230	NA	300	14	16,059
(F-3)	54	NA	133	NA	1,525	600	8	300	17	8,426
(F-4)	52	NA	275	10	1,653	600	6	300	15	16,609
(F-5)	53	NA	275	17	1,129	230	NA	300	15	16,351
(F-6)	52	NA	275	20	1,753	600	5	300	14	16,962
(F-7)	54	NA	275	24	1,241	211	NA	300	13	16,832
(F-8)	54	NA	133	NA	1,525	600	8	300	9	10,764
(F-9)	65[b]	4	65	NA	956	600	9	19	NA	8,215
(F-10)	65	45	275	38	3,061	1,482	3	386	3	19,574
(F-11)	65	61	275	19	1,383	221	NA	362	3	14,343
(F-12)	65	45	275	38	3,061	1,482	3	386	3	19,574

[a]UN represents "unavailable." NA represents "not applicable." Actual data are an average of 1978 and 1979 data; 1978 dollar values were updated to the 1979 price level. Models F-1 through F-3 represent typical farm situations: (F-1) beef/sheep; (F-2) beef; and (F-3) sheep. Models F-4 through F-12 represent alternative management options: (F-4) beef artificial insemination program for a beef/sheep farm; (F-5) beef artificial insemination program for a beef farm; (F-6) calf wintering program for a beef/sheep farm; (F-7) calf wintering program for a beef farm; (F-8) typical sheep model with fixed cost for hay production; (F-9) intensive sheep model; (F-10) typical beef/sheep model with labor hiring activities for hay harvest and calving/lambing seasons; (F-11) typical beef model with labor hiring activities for hay harvest and calving seasons; (F-12) typical sheep model with labor hiring activities for hay harvest and lambing seasons.

[b]This was pasture produced on hayland.

[c]Since no constraint was specified in the model, no shadow price emerged. The figure represents the total amount of labor used, including hired labor.

Table 5

Summary of actual average data for part-time AHP farms and LP model results.[a]

Category (unit)	Net income (dollars)	Cow (head)	Ewe (head)	Pasture (acres)	Hay (acres)	Corn purch. (cwt)	Hay purch. (dollars)	Hay sold (dollars)	Pasture sold (dollars)	Labor hired for calving/ lambing (dollars)	Labor hired for hay harvesting (dollars)
Project data:											
All farms	1,819	32	56	94	45	UN	172	219	UN	UN	UN
Beef/sheep farms	3,641	32	50	78	40	UN	82	24	UN	UN	UN
Beef farms	1,745	33	NA	98	49	UN	181	288	UN	UN	UN
Model results:											
(P-1)	5,082	19	94	107	32	94	0	85	0	NA	NA
(P-2)	3,969	35	NA	106	33	NA	678	0	0	NA	NA
(P-3)	4,778	NA	111	54	32	111	0	2,780	0	NA	NA
(P-4)	4,881	19	94	107	32	94	0	85	0	NA	NA
(P-5)	3,605	35	NA	106	33	NA	678	0	0	NA	NA
(P-6)	5,506	16	95	107	32	95	0	214	0	NA	NA
(P-7)	4,720	29	NA	106	33	NA	458	0	0	NA	NA
(P-8)	3,375	NA	111	54	32	111	0	2,780	0	NA	NA
(P-9)	2,047	NA	111	45[b]	NA	111	1,879	NA	252	NA	NA
(P-10)	6,100	0	154	74	45	154	0	3,890	0	356	183
(P-11)	4,746	32	NA	94	45	NA	0	1,472	0	0	165
(P-12)	6,100	NA	154	74	45	154	0	3,390	0	356	183

Table 5. Continued

Resource (Unit)	Hayland		Total land		Annual labor[c] (hours)	Calving and lambing labor		Hay harvesting labor		Operating capital (dollars)
	Amount (acres)	Shadow price (dollars)	Amount (acres)	Shadow price (dollars)		Amount (hours)	Shadow price (dollars)	Amount (hours)	Shadow price (dollars)	
Project data:										
All farms	45	NA	139	NA	UN	UN	NA	UN	NA	7,859
Beef/sheep farms	40	NA	118	NA	UN	UN	NA	UN	NA	13,026
Beef farms	49	NA	147	NA	UN	UN	NA	UN	NA	7,385
Model results:										
(P-1)	32	NA	139	6	1,002	360	4	180	15	6,938
(P-2)	33	NA	139	10	667	101	NA	180	15	6,513
(P-3)	32	NA	86	NA	918	360	5	180	16	5,276
(P-4)	32	NA	139	2	963	360	5	180	16	7,151
(P-5)	33	NA	139	6	596	101	NA	180	15	6,898
(P-6)	32	NA	139	14	999	360	3	180	14	7,232
(P-7)	33	NA	139	16	655	96	NA	180	14	6,805
(P-8)	32	NA	86	NA	918	360	6	180	8	6,678
(P-9)	45[b]	4	45	NA	576	360	5	11	NA	5,478
(P-10)	45	53	119	NA	1,273	498	3	251	3	7,859[d]
(P-11)	45	62	139	11	769	93	NA	244	3	6,341
(P-12)	45	53	119	NA	1,273	498	3	251	3	7,859[d]

[a]UN represents "unavailable." NA represents "not applicable." Actual data are an average of 1978 and 1979 data; 1978 dollar values were updated to the 1979 price level. Models F-1 through F-3 represent typical farm situations: (F-1) beef/sheep; (F-2) beef; and (F-3) sheep. Models F-4 through F-12 represent alternative management options: (F-4) beef artificial insemination program for a beef/sheep farm; (F-5) beef artificial insemination program for a beef farm; (F-6) calf wintering program for a beef/sheep farm; (F-7) calf wintering program for a beef farm; (F-8) typical sheep model with fixed cost for hay production; (F-9) intensive sheep model; (F-10) typical beef/sheep model with labor hiring activities for hay harvest and calving/lambing seasons; (F-11) typical beef model with labor hiring activities for hay harvest and calving seasons; (F-12) typical sheep model with labor hiring activities for hay harvest and lambing seasons.

[b]This was pasture produced on hayland.

[c]Since no constraint was specified in the model, no shadow price emerged. The figure represents the total amount of labor used, including hired labor.

[d]These two labor hiring models which produced sheep were the only models for which all operating capital was used. The shadow price for operating capital was $.25.

The differences between actual and modeled net income were attributed to variations in yields, resource use, enterprise combinations, and the inability of the LP models to account for the inefficiencies that exist in the real world.

In comparison to actual data, the lower level of operating capital used in the models can be attributed to several factors. Some operating costs which occur on actual farms may not have been included in the models; the average farmer may have had costs which were higher than was necessary to attain his level of output; or the LP models may have presented an optimally managed operation that, in reality, was impossible to attain in a world of imperfections.

In spite of the differences between model results and results based on average data, the authors felt that the models were sufficiently reliable to use for evaluating the economic impacts of selected alternative management strategies. However, when interpreting results, two aspects of research associated with analysis based on models of typical farms should be remembered. First, since the typical models were not perfect representations of actual situations and since the alternative models were developed from the typical models, magnitudes of changes due to the alternative management strategies should be based on comparisons with typical model results rather than comparisons with actual data. Second, it is not likely that either average actual data or typical model results will accurately represent an individual farm situation.

Alternative Management Strategies

Hypothetical budgets and LP models were prepared to estimate farm returns to fixed resources, enterprise combinations, and inputs used for four alternative management plans. It was assumed that the level of resources existed to allow for the incorporation of any one of the four alternatives.

New budgets were designed by adjusting the typical pasture and beef budgets. Nine new models, F-4 through F-12 for full-time farms and P-4 through P-12 for part-time farms, were estimated and compared to typical farm models, F-1 through F-3 and P-1 through P-3 (Tables 4 and 5).

Beef Artificial Insemination

Assuming a hypothetical beef artificial insemination (AI) program, AI budgets were designed. Based on several studies, (Connor, Peters et al., and Inskeep and Lewis), monthly calving percentage and pregnancy rates were estimated. Due to the genetic heritibility of the bull used in an AI program, the average weight of an AI calf was 15 pounds heavier when marketed than a calf produced through natural breeding. The weights of all calves born before or after the actual calving date, March 15, were adjusted by the actual daily gain, 1.95 pounds (Baker et al.). An increased value of $7.50 for an AI calf used as a replacement heifer was budgeted. Additional expenses associated with the AI program were $656 for the 60-cow full-time farm and $328 for the 30-cow

part-time farm. Due to a more concentrated calving season, with AI rather than with natural breeding, the annual labor requirement per cow was reduced from 8 hours to 6 and 6.3 hours in full- and part-time AI budgets, respectively. In comparison to the full-time, 60-cow (part-time, 30-cow) beef budget with natural breeding, the AI budget reflected a decrease in total marketed calf weight of 45 (22) pounds. This decrease occurred because a portion of the cows were bred later under an AI program than with natural breeding. Cows bred later produced lighter calves by the October marketing date. The annual returns to fixed resources and feed per cow were $241.28 and $201.48 for full- and part-time farms, respectively.

LP models F-4 (P-4) and F-5 (P-5), reflecting changes in production activities and resource coefficients, were run and compared to typical models for the full-time (part-time) beef/sheep and beef farms, models F-1 (P-1) and F-2 (P-2), respectively. Models F-4 and F-5 incomes were within 98 and 97 percent of the typical full-time farms; models P-4 and P-5 were within 96 and 91 percent, respectively, of the typical part-time farms. Thus AI does not appear to to be more profitable than current practices, and AI is more attractive to full-time than to part-time farms. Yet, the AI income may have been understated. Compared to the $7.50 added value per AI calf used as a replacement, Singleton and Petritz (1976) have estimated an added value as high as $15 and Herrick's estimate was as much as $26.40 (1976).

To maintain records on heat detection and conception rates, a producer must observe cows more closely during calving. Although this higher level of management is difficult to appraise, it is a critical area affecting profits.

Calf Wintering

The calf wintering option was designed to represent a hypothetical management system where the producer would winter one half of his raised feeder calves. Two budgets, stocker and yearling, were prepared for each farm category. Each wintered calf was fed 3 pounds of ground ear corn, 1 pound of soybean meal, and 11 pounds of non-legume hay per day to attain an average weight of 619 or 608 pounds for a full-time or a part-time farm, respectively, by a May 1 marketing date. Health care, marketing, and labor cost increases were budgeted. The full- and part-time budgets with half of the calves sold as stockers showed receipts minus cash costs of $253 and $219 per cow, respectively.[12]

The yearling budgets reflected the increase in pasture requirements and returns per cow if half of the calves would have been wintered and marketed around October 15. Starting with the initial stocker weight of 619 or 608

---

[12]Prices for stockers and yearlings relative to AHP calf prices were estimated from Kansas City market data (USDA, 1974–1984) averaged over an 11-year time period. A detailed explanation of the price determination may be found in Reda et. al. Receipts minus cash costs figures do not include costs of on-farm hay and pasture production.

pounds for full- or part-time farms, respectively, and an average daily weight gain of 1.5 pounds, the receipts minus cash costs per cow equaled $311 and $274.

The calf wintering LP model was designed to select either a stocker program, wintering half of the calves until spring; or a yearling program, keeping wintered calves through the summer; or a combination of both half stocker and half yearling options. Models F-6, P-6, F-7, and P-7 ranged from 8 to 19 percent more profitable than the beef/sheep and beef models for both farm categories. The stocker activity was not included in the model's results; therefore, based on the data used, the option to winter calves was economically desirable only if calves were pastured after being wintered.

The profit level of this model may have been overstated because the associated enterprise budgets reflect the second year after a calf wintering program started; and the analysis did not consider the income that was postponed by initially keeping one half of the calves.

Intensive Sheep

The intensive sheep program was designed to represent a hypothetical situation in which hay production was eliminated in 1979. Since the hay requirement was significantly greater for beef than sheep, it was thought that a farm producing sheep and buying hay might be more profitable than a combination beef/sheep operation. This deliberately planned diminution in beef production that implied product conversion towards a larger sheep flock was possible—especially if the surplus hay land had been used for pasture, as assumed in this analysis. The objective of this study was to determine the economic feasibility of producing sheep at a level which did not exist in the Project area. The data used to budget the returns per ewe were the same as those used for the typical sheep model.

Assuming that hay land would have been more productive than pasture land, an alternative pasture budget was prepared to represent higher yields. Based on data from the AHP area (Baker, p. 173) the average annual yield per acre for all AHP farms was 6,973 pounds of dry matter. The intensive sheep models F-9 and P-9 were constructed by including a hay purchasing activity[13] and a second pasture producing activity that replaced the hay producing activity.

A typical sheep plan, models F-8 and P-8, which included the fixed costs of hay production, was used as a basis of comparison to models F-9 and P-9. The full-time intensive sheep model F-9 income was 29 percent less than model F-8 while the same quantity of sheep, 186, was raised. The value of hay purchased in model F-9 was $3,115, whereas there was no hay purchased in model F-8; thus, part of the difference in net income could be attributed to hay sales of $4,954 in model F-8. The comparative models for the part-time group showed 39 percent less profit when purchasing hay to raise 111 sheep. Model P-8 was more profitable than model P-9 partly because of hay sales equal to $2,780.

[13]The cost of purchasing a high quality mixed hay was assumed to be $56.00 per ton.

These results raise the question, "Should the valid model of comparison for the intensive plan include a hay selling activity?" When models F-8, and P-8 were run prohibiting hay sales, the income was respectively $5,943 for full-time farms and $2,562 for part-time farms. Although both of these income figures were closer to the results of the intensive sheep models than were results of model F-8 and P-8, they were still 11 and 25 percent greater, respectively. It was concluded that even if a farm is not able to sell hay, it is more profitable for a sheep farmer to produce his own hay than to buy hay.

Labor Hiring

The typical models included shadow prices ranging from $4 to $17 for seasonal labor.[14] To test the profitability of hiring labor, it was not necessary to create any new budgets.

The final three models, F-10 through F-12 and P-10 through P-12, for a beef/sheep, beef, and sheep farm, respectively, included labor hiring activities at the 1979 hourly wage rate of $2.58 (USDA 1981, p. 432) for the June hay harvest and calving/lambing seasons. The optimal solutions for the beef/sheep/labor model F-10 and P-10 and the sheep/labor model F-12 and P-12 were identical for both farm categories. The cow/calf activity was not selected due to the higher profitability of sheep production compared to beef production. The model for the full-time (part-time) category, included 882 [138] hours of hired labor for the lambing season and 86 [71] hours of hired labor for the June hay harvest season. The optimal incomes of the full-time, (part-time) beef/sheep/labor model and sheep/labor model were 37 [20] percent and 60 [28] percent greater than the respective typical beef/sheep and typical sheep models.

The beef/labor model F-11 and P-11 results featured a net income that was approximately 8 and 20 percent greater than the typical beef model results for the full- and part-time farms, respectively. For both categories, fewer cows were included in the optimal solution than were shown in typical models. While it was profitable to hire labor during the haying season, it was not profitable to hire labor during the calving season. Thus, for the full-time model, the 8 percent increase in income can be attributed to a smaller amount of purchased hay; 62 hours of hired labor corresponding to a 23 percent increase in acres of hay production; and a 53 percent decrease in hay purchases. The part-time model's increased income was primarily the result of increased hay production; an additional 64 hours of hired labor corresponding to a 36 percent increase in acres of hay production; and a substantial increase in hay sales.

---

[14]The shadow price indicates how much returns to fixed resources could be increased by the addition of one more unit of a limited resource.

Survey of AHP Farmers

To evaluate the potential for adoption, a telephone survey was designed to asess the 1978–79 AHP participants' reactions to the alternative management systems. To distinguish responses from those already adopting an alternative strategy, part of the questionnaire was designed to ascertain 1982 management practices.

Since there were only 56 participants in 1978–79, an attempt was made to interview the entire population. Interviews were completed with 48 farmers, or 86 percent of the population. The remaining 14 percent could either not be contacted by telephone or were no longer farming.

Marketing Beef Cattle

Eighty-one percent of the farmers marketed 50 percent or more of their calf crop as feeder calves in the fall (Figure 1). Of the 48 farmers surveyed, 19, 1, 4, and 2 marketed 100 percent of their calf crop as calves, stockers, yearlings, or other, respectively (Table 6). The remaining 22, or 46 percent, sold their calves as a combination of two or more of the above categories. Eleven of the 22 farmers marketed their calf crop as a combination of only calves and stockers. Ten farmers sold all or part of their calf crop as yearlings. Of these 10 farmers, 8 sold 50 percent or more of their calf crop as yearlings. The most important reason cited for not keeping raised calves as yearlings was a shortage of resources, i.e., cash, feed, labor, land, buildings, or facilities.[15]

Ten farmers wintered 50 percent or more of their calves for sale as yearlings or older cattle. Of the remaining 38 who did not keep calves as long, 23 replied positively to the question, "Would you be willing to keep 50 percent of your raised calf crop until the following fall if it were 10–20 percent more profitable?" Of the ten who responded, "Maybe or not sure" to the same question, five said that risk or a lack of resources were the main reasons for hesitating to consider the yearling option. Five who responded "No," stated they were unwilling to consider this program because of a lack of resources only.

The cooperators' acceptance of the calf wintering option was very favorable. Some were eager to obtain more information in order to adjust their marketing strategies.

Hiring Labor

Sixty-seven percent of the respondents hired labor in 1982. The 48 farmers interviewed averaged 406 hours of hired labor per year at an average wage rate of $3.23 per hour. The farms which hired labor during the haying season hired almost 130 hours of labor per month in June through August (Figure 2). On a

---

[15]Farmers were asked if they bought calves for resale. Twenty percent said yes.

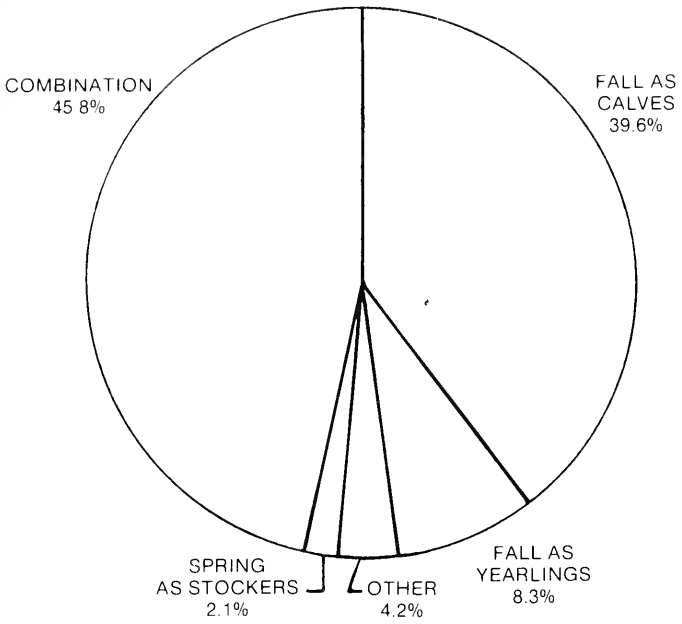


Figure 1. Marketing strategies of AHP farmers, 1982.

monthly basis, the highest incidence of hired labor occurred in June through August, presumably to harvest hay (Figure 3).

Forty percent of the respondents did not hire additional labor because they felt it cost too much. Thirty-five percent replied that they did not need additional labor. When asked if they were to hire additional labor, 56 percent of the group responded they would have labor work on normal farm chores or construction projects such as building fences and clearing brush.

Only 14 of the 48 farmers surveyed said they would be willing to hire labor to increase sheep production if their profits would increase by a third. Thirteen replied, "Maybe or not sure." Twelve of the 21 remaining farmers said they would not be willing to adopt the strategy due to personal preferences.

The cooperators' acceptance of the hiring labor option was not as favorable as that of the calf-wintering option for two reasons: (1) the cost or an insufficient need, and (2) a disinterest in hiring labor specifically to raise sheep. There was a biased or negative attitude toward raising sheep. Some made note of the predator problem associated with raising sheep while others stated they did not like sheep. Several doubted that hiring labor would increase their profits by 33 percent. The majority said they would have hired labor work on normal farm chores; however, hiring labor for this purpose was not considered to be a profit-earning activity in this study.

Table 6.
Marketing strategies of AHP farmers, 1982.

Number of farmers	Percentage of raised calf crop			
	Feeder calves	Stockers	Yearlings	Other
19	100			
1		100		
4			100	
2				100
2	95	5		
1	95			5
2	90	10		
1	90			10
1	90		5	5
1	85	15		
1	80	20		
1	80	15	5	
1	80	15		5
1	70	30		
2	65	35		
2	50	50		
2	50		50	
2	50			50
1	20		80	
1		50	50	
Total 48				

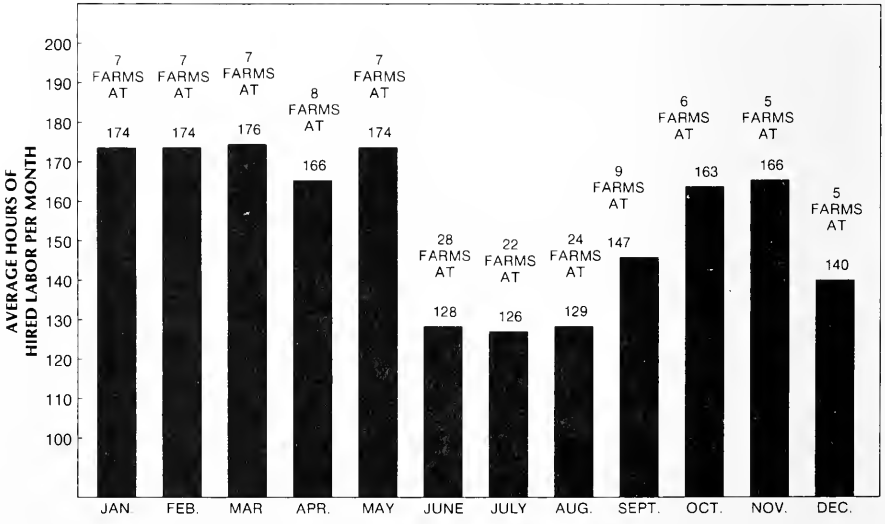


Figure 2. Number of AHP farms hiring labor and average hours of labor hired per month, 1982.

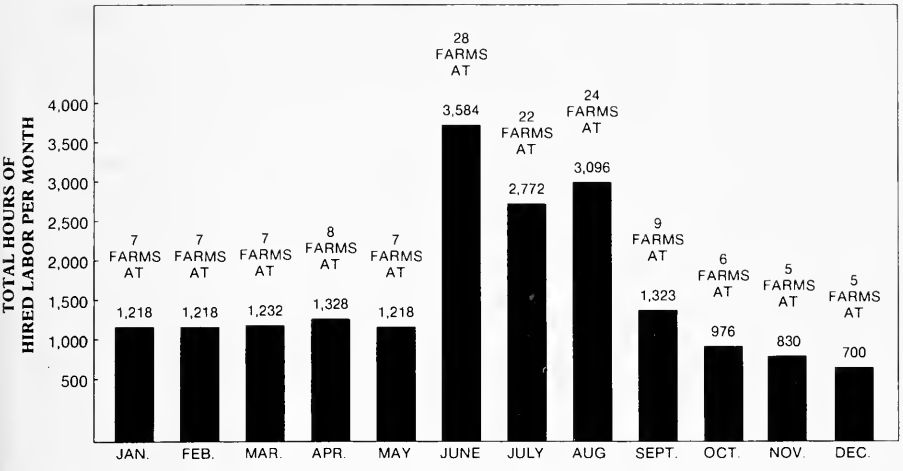


Figure 3. Number of AHP farms hiring labor and total hours of labor hired per month, 1982.

Conclusions

Two of the four alternative management strategies examined in this investigation increased returns to fixed resources. Wintering 50 percent of the calf crop for sale as yearlings and hiring seasonal labor to raise sheep were found to be significantly more profitable than activities currently being practiced on the majority of the modeled farms. Many farmers were interested in the possibility of wintering calves, but fewer farmers were interested in hiring labor to produce sheep. Beef artifical insemination and intensive sheep production with purchased hay were found to be less profitable than typical farm operations.

Results from this study indicate that opportunities exist to improve farm income through alternative management strategies. However, increasing farm income frequently depends on more intensive use of labor and capital, the addition and/or alternation of enterprises, and improved management.

References

Baker, Barton S., Paul E. Lewis, Dale K. Colyer, Frank E. Woodson, E. Keith Inskeep, and Robert H. Maxwell. *Allegheny Highlands Project 1970–1979.* West Virginia University Agr. and For. Exp. Sta., Dec. 1981.

Baker, Barton S. "Production and Species Composition of Hill Pasture Influenced by Lime and Fertilizer," *Hill Lands: Proceedings of an International Symposium.* Eds. Luchok, Cawthon and Breslin. Morgantown: West Virginia University Books, Office of Publications, 1976, pp. 171–174.

Beneke, Raymond R., and Ronald Winterboer. *Linear Programming Applications to Agriculture.* Ames: Iowa State University Press, 1973.

Connor, Ann Louise. "Factors Affecting the Reproductive Performance of Beef Cattle." M.S. thesis, West Virginia University, 1981.

Cooperative Extension Service. *Farm Planning and Financial Management ID-68.* West Lafayette, Indiana: Purdue University, 1980.

Crecink, John C. *Characteristics of Small Farm Families.* USDA EDD ESCS, Nov. 1979.

Herrick, J. B. "Your Best Buy Is A. I." *Curtiss Beef Cattletter.* No. 8 (1976), p. 1.

Inskeep, E. K., and Paul Lewis. *Use of Prostaglandin F_2 and EB in Beef Cattle Management.* West Virginia University, Coll. Agr., Div. An. and Vet. Sci. (not dated).

Orden, David and Dennis K. Smith. *Small Farm Programs: Implications From a Study in Virginia.* Research Division Bull. 135. Blacksburg, Virginia: Virginia Polytechnic Institute and State University, Oct. 1978.

Peters, John B., J. A. Welch, A. L. Barr, and E. K. Inskeep. "Synchronization Estrus and Use of Artificial Insemination in Small Herds of Beef Cattle," *Hill Lands: Proceedings of an International Symposium.* Eds. Luchok, Cawthon, and Breslin. Morgantown: West Virginia University Books, Office of Publications, 1976, pp. 631–634.

Reda, Kimberly Jane. "An Economic Analysis of Management Strategies on Small, Beef/Sheep Farms in West Virginia." M.S. thesis, West Virginia University, 1984.

Reda-Wilson, Kimberly, Robert O. Burton, Jr., Barton S. Baker, and Paul E. Lewis. *Wintering Calves: An Analysis of Potential Returns on West Virginia Farms.* Circular 136. West Virginia University Agr. and For. Exp. Sta., Oct. 1985.

Singleton, W. L., and D. C. Petritz. "Management and Economics of a Beef Cow Herd AI Program." *The Charolois Way,* May 1976, pp. 55–65.

U.S. Department of Agriculture. *Agricultural Statistics 1981.* Washington: U.S. Government Printing Office, 1981.

U.S. Department of Agriculture. *Livestock Detailed Quotations.* AMS LPGS-214, Various Issues 1974–1984.

U.S. Department of Agriculture Cooperating with the West Virginia Department of Agriculture. *West Virginia Agricultural Statistics, 1982.* CRB 13, Nov. 1982.

U.S. Department of Commerce, Bureau of the Census. *1978 Census of Agriculture, Volume I, State and County Data, Part 48, West Virginia.* Washington, 1981.

Appendix

Table A-1
AHP variable descriptions and mean values.

Description (data classification)[a]	Unit	Full-time farms	Part-time farms
Acres of pasture per animal unit	Acres	3.20	3.60
Number of cows and bred heifers	Head	66.34	32.46
Electricity expense	Dollars	222.81	174.45
Number of ewes and bred lambs	Head	136.79	55.78
Income from sale of hay	Dollars	217.86	218.63
Hay produced per acre (dry matter)	Tons	2.88	2.76
Calves marketed per cow	Percent	87.68	85.67
Lambs marketed per ewe	Percent	120.10	121.31
Market weight per calf	Pounds	483.25	472.33
Total operating receipts	Dollars	32871.37	9678.35
Number of pasture acres	Acres	209.60	94.05
Percentage of cows that died during the year	Percent	1.73	1.86
Percentage of ewes that died during the year	Percent	7.83	10.97
Expenses for purchased hay	Dollars	636.37	172.14
Expenses for repairs to real estate	Dollars	869.82	439.72
Expenses for salt & other minerals	Dollars	304.70	104.21
Telephone expense	Dollars	190.40	140.90
Number of tillable acres	Acres	65.48	45.38
Total operating expenses	Dollars	24764.54	7859.33
Total animal units	Animal unit	109.15	43.90
Veterinary and drug expenses	Dollars	654.69	176.89
Dollar value per lamb sold	Dollars	58.75	52.64
Dollar value per calf sold	Dollars	348.88	334.43
Market weight per lamb	Pounds	96.95	89.56

[a]Data were coded and stored at the Division of Resource Management, West Virginia University. Missing data were ignored when calculating means.

Table A-2
Machinery inventory for twenty-six full-time AHP farms.

Machinery category	Total for all farms	Average number per farm	Pieces of machinery per farm, by numbers of farms	Type of machine (pieces of machinery per farm by number of farms)
Balers	32	1.20	8 farms—2 16 farms—1 2 farms—0	UN
Corn harvesting equipment	25	.96	7 farms—2 or 3 7 farms—1 12 farms—0	10 choppers 9 corn pickers 6 ensilage blowers
Small equipment	75	2.90	1 farm—13 13 farms—2 to 12 12 farms—0 or 1	30 saws 10 sprayers
Large equipment used with other machinery	157	6.04	1 farm—17 17 farms—4 to 16 8 farms—0 to 3	49 spreaders 16 post drivers 13 brush hogs 9 blades
Farm and recreational vehicles	10	.38	6 farms—1 or more 20 farms—0	7 motor bikes 3 snowmobiles
Hay harvesting	105	4.04	1 farm—10 11 farms—4 to 9 13 farms—1 to 3 1 farm—0	34 mowers (1 farm—8) (6 farms—2) (14 farms—1) (5 farms—0) 21 rakes (2 farms—2) (17 farms—1) (7 farms—0) 19 tedders (1 farm—3) (1 farm—2) (14 farms—1) (10 farms—0)

Continued

Machinery category	Total for all farms	Average number per farm	Pieces of machinery per farm, by numbers of farms	Type of machine (pieces of machinery per farm by number of farms)
				14 haybines (1 farm—2) (12 farms—1) (13 farms—0)
				11 conditioners (1 farm—2) (9 farms—1) (16 farms—0)
Miscellaneous equipment	130	5	3 farms—15, 20, 23 9 farms—5 to 14 14 farms—1 to 4	42 watering or feeding equipment 17 elevators
Road vehicles	71.5	2.75	1 farm—7 16 farms—3 to 6 8 farms—1 or 2 1 farm—0	UN UN UN UN
Seeding equipment	23	.88	7 farms—2 9 farms—1 10 farms—0	9 corn planters 9 drills
Tillage implements	65	2.5	1 farm—7 7 farms—4 to 6 12 farms—1 to 3 6 farms—0	26 disks (2 farms—3) (2 farms—2) (13 farms—1) (9 farms—0)
				23 plows (1 farm—3) (5 farms—2) (13 farms—1) (7 farms—0)
Tractors	73	2.8	1 farm—6 23 farms—1 to 5 2 farms—0	UN UN UN

Continued

Table A-2 continued

Machinery category	Total for all farms	Average number per farm	Pieces of machinery per farm, by numbers of farms	Type of machine (pieces of machinery per farm by number of farms)
Wagon	48	1.8	2 farms—6	UN
			6 farms—4 or 5	UN
			18 farms—1 to 3	UN
Total	824	32	1 farm—70	UN
			1 farm—4	UN

UN represents "unavailable."

Table A-3
Machinery inventory for thirty part-time AHP farms.

Machinery category	Total for all farms	Average number per farm	Pieces of machinery per farm, by numbers of farms	Type of machine (pieces of machinery per farm by number of farms)
Balers	31	1.02	6 farms—2 or more	
			18 farms—1	
			6 farms—0	UN
Corn harvesting equipment	16	.53	8 farms—1 or more	8 choppers
			22 farms—0	4 pickers
Small equipment	62	2.07	2 farms—8	20 saws
			11 farms—2 to 7	6 sprayers
			17 farms—0 or 1	
Large equipment used with other machinery	118	3.93	1 farm—10	40 spreaders
			13 farms—4 to 9	15 blades
			16 farms—0 to 3	
				11 brush hogs
				6 post drivers
				6 post diggers

Continued

Machinery category	Total for all farms	Average number per farm	Pieces of machinery per farm, by numbers of farms	Type of Machine (pieces of machinery per farm by number of farms)
Farm and recreational vehicles	13	.43	5 farms—1 or more 25 farms—0	12 motor bikes 1 camper
Hay harvesting equipment	89	2.96	1 farm—8 7 farms—4 to 7 19 farms—1 to 3 3 farms—0	33 mowers (1 farm—3) (8 farms—2) (14 farms—1) (10 farms—0) 25 rakes (1 farm—4) (2 farms—2) (17 farms—1) (10 farms—0) 12 conditioners (2 farms—2) (8 farms—1) (20 farms—0) 11 tedders (1 farm—2) (9 farms—1) (20 farms—0)
Miscellaneous equipment	51	1.70	1 farm—9 1 farm—6 20 farms—1 to 4 8 farms—0	12 elevators 12 feeding equipment
Road vehicles	44	1.47	1 farm—5 28 farms—1 or 3 1 farm—0	UN UN UN
Seeding equipment	16	.53	1 farm—3 2 farms—2 9 farms—1 18 farms—0	8 drills 5 corn planters

Continued

Table A-3 continued

Machinery category	Total for all farms	Average number per farm	Pieces of machinery per farm, by numbers of farms	Type of Machine (pieces of machinery per farm by number of farms)
Tillage implements	51	1.7	3 farms—4 21 farms—1 to 3 6 farms—0	21 plows (4 farms—2) (13 farms—1) (13 farms—0) 13 disks (2 farms—2) (9 farms—1) (20 farms—0)
Tractors	61	2.03	1 farm—4 27 farms—1 to 3 2 farms—0	UN UN UN
Wagons	35	1.17	2 farms—4 17 farms—1 to 3 11 farms—0	 UN
Total	585	19.5	1 farm—36 28 farms—2 to 35 1 farm—1	 UN

UN represents "unavailable."